IOWA STATE UNIVERSITY
Institute for Transportation

Improving the Accuracy and Usability of Iowa Falling Weight Deflectometer Data

tech transfer summary

A high-quality, easy-to-use, backcalculation software package called Iowa Pavement Backcalculation (I-BACK) was developed to achieve the project goals.

May 2013

RESEARCH PROJECT TITLE
Improving the Accuracy and Usability of Iowa Falling Weight Deflectometer Data

SPONSOR
Iowa Department of Transportation
Federal Highway Administration
(InTrans Project 11-419)

PRINCIPAL INVESTIGATOR
Halil Ceylan
Associate Professor, Civil, Construction and Environmental Engineering
Iowa State University
515-294-8051
hceylan@iastate.edu

CO-PRINCIPAL INVESTIGATORS
Kasthurirangan Gopalakrishnan
Research Assistant Professor
Iowa State University

Sunghwan Kim
Research Assistant Professor
Iowa State University

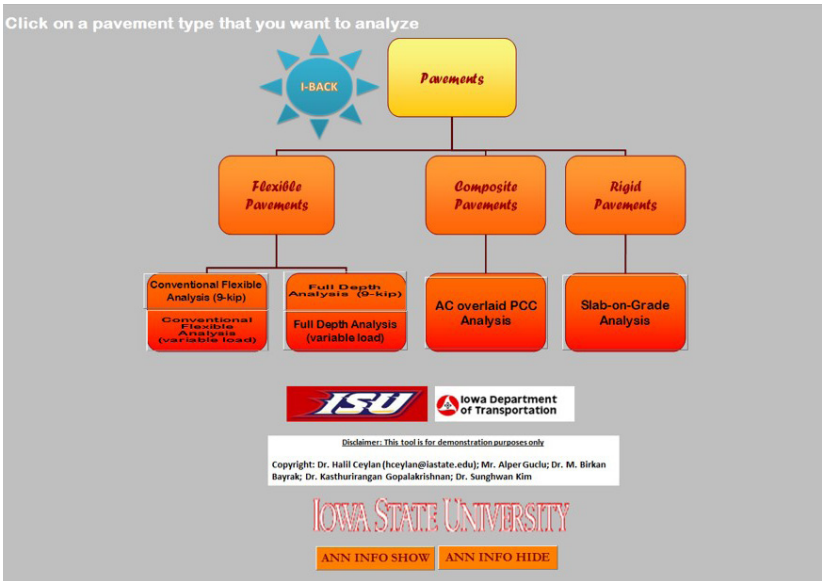
FOR MORE INFORMATION
www.instrans.iastate.edu

Background

Highway agencies periodically evaluate the structural condition of roads as part of their routine maintenance and rehabilitation activities. The falling-weight deflectometer (FWD) test measures road surface deflections resulting from an applied impulse loading, simulative of a truck passing on the highway. The measured surface deflections are utilized to determine pavement layer stiffnesses through a backcalculation type structural analysis.

Although the Iowa Department of Transportation (DOT) has been collecting the FWD data on a regular basis, the pavement layer moduli backcalculation techniques used so far have been cumbersome and time consuming. More efficient and faster methods in FWD test data analysis were deemed necessary for routine analysis.

Previous Iowa DOT research projects focused on developing advanced pavement layer moduli backcalculation models using the artificial neural networks (ANN) methodology. The developed models were successfully validated using field data and incorporated into a Microsoft Excel spreadsheet-based backcalculation software toolbox with a user-friendly interface.



Iowa Backcalculation (I-BACK) software screen shot

Institute for Transportation
Iowa State University
2711 S. Loop Drive, Suite 4700
Ames, IA 50010-8664
515-294-8103

The mission of the Institute for Transportation (InTrans) at Iowa State University is to develop and implement innovative methods, materials, and technologies for improving transportation efficiency, safety, reliability, and sustainability while improving the learning environment of students, faculty, and staff in transportation-related fields.

SPR RB04-012

Objectives

This study was undertaken with the objectives of improving the accuracy and usability of Iowa FWD data and the pavement inverse analysis tools. Based on the requirements by the technical advisory committee (TAC) members representing potential users of the developed backcalculation software system at the Iowa DOT, significant enhancements were incorporated into the fully-automated software system for rapid processing of the FWD data.

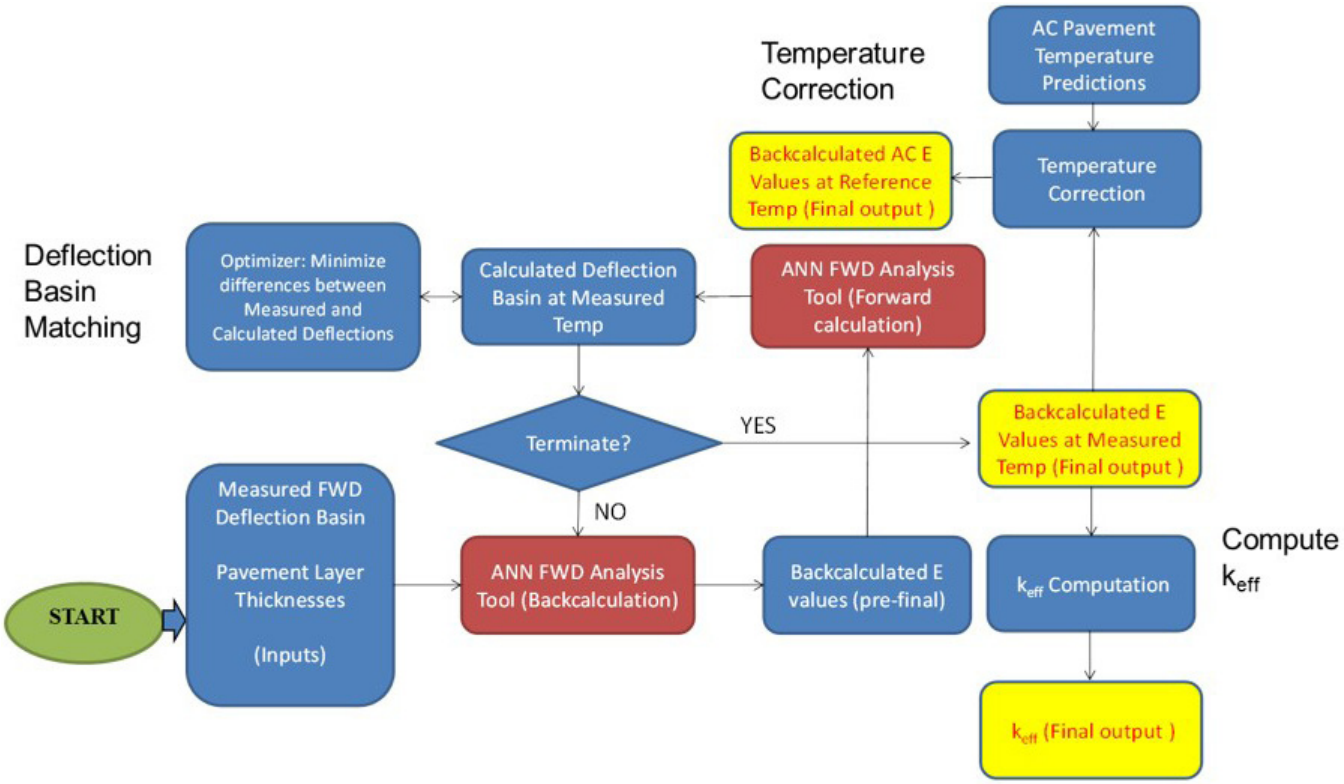
These enhancements include the following:

- Refined prediction of pavement layer modulus through deflection basin matching/optimization
- Temperature correction of HMA layer modulus
- Computation of 1993 AASHTO design guide-based effective structural number and effective k-value
- Computation of Iowa DOT asphalt concrete (AC) overlay design-based structural rating (SR) and k-value
- Enhancement of user-friendliness of input and output from the software tool

Implementation Readiness and Benefits

A high-quality, easy-to-use, backcalculation software package called Iowa Pavement Backcalculation (I-BACK) software was developed to achieve the project goals and yielded the following highlighted benefits:

- Provides more-fine-tuned ANN pavement backcalculation results by implementation of deflection matching optimizer for conventional flexible, full-depth, rigid, and composite pavements
- Provides temperature normalized/corrected hot-mix asphalt (HMA) layer modulus at a standard reference temperature for conventional flexible, full-depth and composite pavements
- Provides effective SNeff and the effective k-value as final outputs for pavement/asset management purposes
- Provides SR and k-value as final outputs to make FWD deflection measurements suitable for use in the existing Iowa DOT AC overlay design procedure
- Produces separate smaller-sized output files from backcalculation analysis



I-BACK composite pavement analysis flow sequence